REMARKS/ARGUMENTS:

This Reply is in response to the Final Office Action mailed on February 13, 2004 and is filed along with a petition for one-month extension of time along with the required statutory fee for the extension. In the Office Action, claims 1-37 were all rejected. In this Reply, claims 1, 2, 7, 9, 13-15, 19, 21 and 33-37 have been amended, claims 12, 15, 16, 20-23, 30-32 and 38-43 have been cancelled. As a result of the amendments herein, the phrase "polyhalide ion" which was determined to represent new matter by the Examiner has been removed from all claims. This Reply is filed along with:

i. A request for Continued Examination (RCE) and authorization to charge the statutory fee for the RCE,

ii. An IDS submitting U.S. Pat. No. 6,656,369 to Krishnan et al. along with a certification under 37 CFR 1.98(e)(2), and

iii. A Declaration under Rule 131 from inventor Dr. Singh accompanied by Laboratory Notebook evidence showing a date of invention for the claimed invention before the filing date as a reference afforded to U.S. Pat. No. 6,656,369 to Krishnan et of January 17, 2002.

Turning now to rejections based on art, claims 1-37 were rejected based on U.S. Pat. No. 6,290,736 to Evans or U.S. Pat. No. 5,700,383 to Feller et al. With regard to certain dependent claims, these references were combined with other secondary art.

Applicants will now review the claimed invention as now recited in amended claim 1, which is believed to clearly distinguish over the cited art. Amended claim 1 recites a slurry for chemical mechanical polishing (CMP) and includes a solution having (i) a halogen comprising salt and (ii) at least one species selected from the group of diatomic VIIA elements consisting of I_2, Br_2 and F_2. Applicants' Example 8 clearly discloses this claimed slurry combination. The

claimed halide comprising salt allows the claimed diatomic VIIA element consisting of a I_2, Br_2 or F_2 to dissolve in the slurry solution and form a reactive specie(s) and thus provide the desired formation of a soft metal halide layer formation on the metal surface being polished.

The formation of a metal halide layer on the surface of the metal being having a hardness less than the metal layer being polished is an unexpected result. Consider the following noted in the background of the application regarding conventional CMP slurries on page 9, lines 3-9:

Use of an oxidizer such as hydrogen peroxide in a copper CMP slurry forms a thin copper oxide (Cu_2O; known as cuprite) layer on the copper or copper alloy surface. Copper oxide is an oxide whose hardness on the Mohs scale is greater than copper. The Mohs scale is a hardness scale having a range from 1 to 10, with 10 being the hardest material (diamonds). Cuprite has a Mohs hardness of 3.5 to 4, while the underlying copper layer has a Mohs hardness of from 2.5 to 3. Under certain conditions, copper II oxide (CuO), (also known as tenorite) may be formed instead of, or in addition to Cu_2O. CuO also has a hardness of 3.0 to 4. Thus, both CuO and Cu_2O have a hardness greater than copper.

Accordingly, conventional slurries teach formation of a metal compound surface layer (e.g. CuO) that is more chemically reactive as compared to the elemental metal (e.g. Cu metal), but is harder that the corresponding elemental metal. A hard surface layer generally requires the CMP process to utilize a high concentration of highly abrasive particles, which result in scratching, dishing and other undesirable yield limiting effects. Applicants' slurry was found to readily form metal halide surface layers, such as copper iodide (CuI) or silver iodide (AgI), which were found to be surprisingly softer that the corresponding metal being polished. Accordingly, Applicants' slurry can be operated using either no particles (pad only), or soft particles which have a hardness less than the metal layer being polished by the slurry (see claims 4-6) or the surrounding dielectric layer (e.g. SiO_2). Alternatively, a low concentration, disclosed as being preferably less than 1 wt. % of nanosize hard particles, can also be used with the invention. Such particles would not effectively polish the underlying metal. Thus, not only is

Applicants' claimed slurry novel and non-obvious, the application also provides clear and convincing evidence of unexpected results.

Turning now to the cited art, Evans discloses a slurry and CMP process to polish a noble metal surface. The slurry and polishing process are used to form a damascene, or dual damascene noble metal inlay. The slurry includes single element halogen molecules, such as bromine (Br_2), in a strongly basic aqueous solution to chemically react with the noble metal being polished. With an abrasive added, the slurry is used in a CMP process to polish and remove noble metals from the wafer surface.

Evans teaches reducing the reduction potentials of the noble metals to be polished by increasing the pH of the slurry (col. 3; lines 56-57). Evan's strongly basic solution provides an excess of hydroxide ions to convert the elemental halogen (e.g. Br_2) to a halide ion (col. 4; lines 16-38). The strongly basic solution is disclosed to be a pH greater than approximately 10, and preferably 11-13 (col. 3, lines 66 to col. 4 line 1). Iodine (I_2) is disclosed to be ineffective due to its insufficient oxidation potential (col. 4; lines 44-45).

Although Evans discloses Applicants' claimed diatomic VIIA element, Evans does not disclose or suggest Applicants' claimed halogen comprising salt and thus cannot form the reactive specie(s) and obtain the associated benefit generated by Applicant's combination of a halogen comprising salt and diatomic VIIA elements consisting of I_2, Br_2 or F_2. Accordingly, Applicants submit that amended claim 1 is patentable over Evans.

Feller discloses slurries and methods for the chemical mechanical polishing of thin films used in integrated circuit manufacturing. A first slurry comprises an oxidant, such as water, a halogen, such as fluorine, an abrasive, such as silica, and a chelating agent, such as citric acid, and has a pH between four and nine. The first slurry is for CMP of the aluminum film. The

fluorine is disclosed for increasing the rate of removal of aluminum oxide by creating a pitting potential between the oxide surface and the aqueous solution (col 4; lines 48-51). Another (second) slurry comprises an abrasive, such as silica, and an acid, such as citric acid, and has a pH of approximately three. The second slurry is for the CMP of titanium aluminide and is compatible with the first slurry.

A reading of Feller makes clear that when Feller uses the term "halogen", he is always referring to a halide ion, such as F^-, not a single elemental diatomic halogen molecule. The two examples of "halogen" provided by Feller are both fluorine ions provided by the ionic compounds KF and NaF. Feller does not disclose or suggest any of Applicants' claimed diatomic VIIA elements. Thus, Feller cannot form the reactive specie(s) and associated benefits generated by Applicant's claimed combination of halogen comprising salt and diatomic VIIA elements consisting of a I_2, Br_2 or F_2. Accordingly, Applicants submit that amended claim 1 and all claims dependent thereon are patentable over Feller.

The cited references, including the secondary references, whether alone or in combination, fail to disclose or suggest Applicant's slurry solution recited in amended claim 1 which includes the combination of a halogen comprising salt and diatomic VIIA elements consisting of I_2, Br_2 or F_2. Accordingly, Applicant submits that amended claim 1 and its respective dependent claims are patentable claims.

Amended independent claim 33 now recites a slurry for chemical mechanical polishing (CMP) including a solution having a pH of <9 and including at least one nitrogen containing organic passivating additive together with the diatomic VIIA element I_2. Although Evans discloses I_2, as noted above I_2 is taught away as it is disclosed to be ineffective due to its insufficient oxidation potential (col. 4; lines 44-45). Moreover, as noted above, Evans teaches a

strongly basic pH of at least 10, and preferably 11-13 as compared to Applicant's claimed pH of <9. Feller discloses a slurry including the halogen ion F^-, provided by either KF or NaF, not any diatomic VIIA elements, such as the claimed I_2 recited in amended claim 33. Accordingly, Applicants submit that amended claim 33 and all claims dependent thereon are patentable over the cited art.

An IDS submitting U.S. Pat. No. 6,656,369 to Krishnan et al. along with a certification under 37 CFR 1.98(e)(2) accompanies this filing. Krishnan was identified by Applicants in a search performed in the last month. Although Applicants note that Krishnan discloses a method for fabricating a scanning probe microscope probe and does not relate to the CMP slurries at all, Applicants have included an executed Rule 131 Declaration along with evidence comprising laboratory notebook pages that establish a date of invention at least as early as March 19, 2001. Since the filing date afforded to Krishnan as a reference is January 17, 2002, based on the evidence provided, Krishnan is not a citable reference for application to the claimed invention.

Applicants have made every effort to present claims which distinguish over the cited art, and it is believed that all claims are in condition for allowance. However, Applicants invite the Examiner to call the undersigned if it is believed that a telephonic interview (direct line (561) 671-3662) would expedite the prosecution of the application to an allowance. The Commissioner for Patents is hereby authorized to charge any deficiency in fees due or credit an excess in fees with the filing of the papers submitted herein during prosecution of this

application to Deposit Account No. 50-0951.

Respectfully submitted,

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